

REMARKS

Upon entry of the foregoing amendments, claims 1 to 20 will be pending in the above-identified patent application.

The Final Office Action dated January 19, 2007 ("the Action") includes rejections under 35 U.S.C. § 103(a). In view of the above amendments and the following remarks, reconsideration and withdrawal of the rejections are requested respectfully.

Summary of Examiner Interview

Applicant gratefully acknowledges the very helpful telephone interview granted by the Examiner on April 2, 2007. Applicants have amended the claims to address the Examiner's concerns as discussed further below.

Consistent with the Examiner's Response to the Arguments in the Action, the Examiner stated that the claims were being interpreted as a process for cleaning a reactor used to deposit TiO₂, not for a process for removing TiO₂ from a reactor used to coat TiO₂ onto an article. It was agreed that amendments to the claims – that made clear that the process was for *removing* TiO₂ – would overcome the presently pending obviousness rejections as none of the cited references are directed to removing TiO₂ from a reactor.

Applicants hope sincerely that the present amendment, and the remarks below, comply with the Examiner's requirements, overcome the last remaining issues, and place this application into condition for allowance.

Discussion of Applicant's Invention and Claim Amendments

Applicants' claimed invention is directed to a process for removing TiO₂-containing substances from a reactor that is used to coat one or more articles with TiO₂. The process includes the following steps:

- (1) providing the reactor to be cleaned wherein the reactor contains a chamber comprising a surface other than the article at least partially coated with a substance comprising TiO₂;
- (2) adding to the reactor a reactive gas comprising at least one cleaning gas;
- (3) reacting the TiO₂ with the reactive gas to form at least one volatile product; and
- (4) removing from the reactor the at least one volatile product.

Applicants' process is also directed to using the above cleaning process following a process for the deposition of TiO₂ coating on a glass article.

Claims 1 and 15 have been amended to make clear that applicant's process is directed to removing TiO₂ from a reactor, wherein the reactor is used to coat TiO₂ onto an article, from reactor surfaces other than the article. The TiO₂ is reacted with the reactive gas to form at least one volatile product which is removed from the reactor. Support for this amendment can be found throughout the specification and, for example, at paragraphs 12, 13, and 17. No new matter has been added.

Discussion of the Rejections Under 35 U.S.C. § 103(a)

Applicants hereby address the rejections made in the Final Action dated January 19, 2007.

Based on the above amendments, the presently pending rejections do not establish a *prima facie* case of obviousness. "To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a

reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations." MPEP § 2143. Here, the combined references do not teach or suggest all the claim limitations nor is there a suggestion or motivation to combine the references.

Sandhu et al. in view of Giolando

Claims 1-4, 12 and 14-18 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,554,910 to Sandhu et al. in view of U.S. Patent Publication 2002/0071912 to Giolando.

Claims 1 and 15 have been amended to make clear that applicant's claimed process is directed to *removing TiO₂* from reactor surfaces other than the article.

Conversely, Sandhu et al. is directed to a method for removing *TiCl₄-derived* residues in semiconductor processing chambers with treatment gases that convert the residues to substantially stable and/or removable materials. For example, Sandhu et al. discloses removing TiCl₄-derived residues by neutralizing and/or removing using a treatment gas comprising ammonia. (Sandhu et al. at col. 2, lines 52-54). Sandhu et al. also discloses removing TiCl₄-derived residues containing chlorides of titanium in forms having three or less chlorine residues. In particular, Sandhu et al. teaches flooding a reactor having TiCl₄-derived residues with NH₃ to form substantially stable and removable adduct salts. The reactor is then opened for wet or mechanical cleaning. (Sandhu et al. col. 6, lines 30-35). Sandhu et al. also teaches using Cl₂ or HCl to convert TiCl, TiCl₂ or TiCl₃-containing residues to TiCl₄-containing treatment products for removal. Sandhu et al. does not disclose a process for removing *TiO₂-containing substances*.

As discussed above and made abundantly clear by the present amendments, claims 1 and 15 are directed to processes for removing TiO₂ from a reactor that is used to coat one

or more articles with TiO₂. Moreover, claim 1 specifically recites the step of reacting the TiO₂ with a reactive gas. Sandhu et al. does not teach these claim limitations. While Sandhu et al. is directed to a cleaning process, Sandhu et al. speaks of removing TiCl₄-containing substances not *TiO₂-containing substances*. In fact, Sandhu et al. teaches ***avoiding the undesirable production of TiO₂-containing substances in the first place:***

Reactions between air and/or moisture and TiCl₄ -derived residues deposited on reactor chamber walls are undesirable for many reasons. White smoke generated from these reactions actually consists of fine particles, such as of the form TiO_x, which may eventually settle from the air, coating surfaces within the fabrication clean room where they may contaminate devices or wafers. In addition, products of the above reaction, such as HCl and/or chlorine may be prone to causing accelerated corrosion of aluminum chamber walls

(Sandhu at col. 4, lines 43 to 51). Accordingly, Sandhu et al. does not teach the removal of TiO₂-containing substances but rather teaches the removal of substances such as TiCl₄ which if exposed to moisture or oxygen could convert to TiO₂.

The Giolando et al. reference does not cure the deficiencies in Sandhu et al. Giolando et al. is directed to ligated compounds of tin, titanium, and zinc for preparing uniform, high quality metal oxide coating on glass and other substrates. Giolando et al. also discloses a process for the chemical vapor deposition of a metal oxide film onto a heated substrate by using such ligated compounds. In the background section, Giolando et al. disclose that titanium oxide films have been prepared by using titanium tetrachloride. (Giolando et al. at ¶ 4). Giolando et al. does not disclose a cleaning process much less a cleaning process designed to remove the non-volatile and relatively inert TiO₂.

In the Action, Giolando et al. is relied upon for the unremarkable proposition that TiCl₄ can be used during a CVD process to deposit titanium oxide on a suitable substrate. Applicants do not dispute that it was known that TiCl₄ can be used to deposit a film of TiO₂ on a substrate. However, like Sandhu et al., Giolando et al. does not teach the removal of TiO₂

from the chamber surfaces. In fact, the Examiner states Giolando is evidence of “a procedure well known in the art that leaves TiCl₄ deposits on the chamber surface.” (Action at p. 4). Accordingly, neither Sandhu et al. nor Giolando et al. teach the removal of TiO₂-containing substances.

Moreover, the Action does not provide a valid suggestion or motivation to combine these references. The Action states that “it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Sandhu et al. to explicitly state that the TiCl₄ is used to deposit titanium oxide as taught by Giolando in order to use a precursor well-known in the art to deposit metal source materials for semiconductor applications.” (Action at p. 5). Whether one of skill in the art would be motivated to use TiCl₄ to deposit titanium oxide for semiconductor applications is besides the point. Applicants’ claimed process is directed to removing TiO₂-containing substances by using a reactive gas. This combination of references does not teach the claimed process. Additionally, as Sandhu et al. specifically discloses preventing the formation of TiO₂, one of skill in the art would not be motivated to look to a reference directed to forming TiO₂ films.

Accordingly, the combination of Sandhu et al. in view of Giolando et al. cannot be relied on to establish a *prima facie* case of obviousness of claims 1-4, 12 and 14-18.

Sandhu et al. in view of Giolando in further view of Ameen et al.

Claims 5-7, 9-10, and 19-20 are rejected under 35 U.S.C. §103 (a) as being unpatentable over Sandhu et al. in view of Giolando as applied above, and further in view of U.S. Patent No. 6,635,569 to Ameen et al.

Sandhu et al. and Giolando are discussed above.

Ameen et al. is directed to a method of maintaining the stability of a plasma enhanced chemical vapor deposition (PECVD) which includes a cleaning process that facilitates reactor

break-in, reactor and process recovery and process stabilization. Ameen et al. is concerned with the buildup of Ti and other $TiCl_x$ compounds on the reactor component surfaces to prevent the buildup from flaking off and contaminating wafers being processed in the reactor. (Ameen et al. at col. 7, lines 39-43). Ameen et al. discloses the use of cleaning gases such as NF_3 , ClF_3 or Cl_2 to remove the $TiCl_x$ -containing residue from the reactor. Ameen et al. does not disclose a process for removing *TiO₂-containing substances*.

As Ameen et al. does disclose a process for removing TiO_2 -containing substances, it does not cure the deficiencies of Sandhu et al. and Giolando discussed above, and cannot be used in combination with Sandhu et al. or Giolando as the basis of a *prima facie* case of obviousness of claims 5-7, 9-10 and 19-20.

Sandhu et al. in view of Giolando in further view of Ameen et al. and Shang et al.

Claims 11 and 13 are rejected under 35 U.S.C. § 103 (a) as being unpatentable over Sandhu et al. in view of Giolando as applied above, and further in view of Ameen et al. and U.S. Patent No 5,788,778 to Shang et al.

Sandhu et al., Giolando, and Ameen et al. are discussed above.

Shang et al. is directed to a method of cleaning a deposition chamber that is used in fabricating electronic devices. Shang et al. discloses using a remote plasma to activate a cleaning gas. (Shang et al. at col. 2, lines 34-56). Shang et al. does not disclose a process for removing *TiO₂-containing substances*.

As Shang et al. does not disclose a process for removing TiO_2 -containing substances, it does not cure the deficiencies of the other references discussed above, and cannot be used in combination with these references as the basis of a *prima facie* case of obviousness of claims 11 and 13 which depend from claim 1.

Sandhu et al. in view of Giolando in further view of Shang et al.

Claim 8 is rejected under 35 U.S.C. § 103 (a) as being unpatentable over Sandhu et al. in view of Giolando as applied above, and further in view of Shang et al.

Sandhu et al., Giolando and Shang et al. are discussed above.

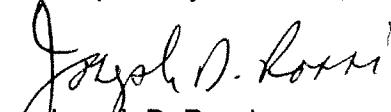
As discussed above, the combination of these references do not teach all the limitations of independent claims 1 and claim 15. Thus, these references cannot be used as the basis of a *prima facie* case of obviousness of claim 8 which depends on claim 1.

Conclusion

In view of the foregoing amendments and remarks, applicants assert that the claims are in condition for allowance, and request respectfully issuance of a Notice of Allowance. If any issues remain, the undersigned requests a telephone interview prior to the issuance of an action.

The Commissioner is hereby authorized to charge the fee required and any additional fees that may be needed to Deposit Account No. 01-0493 in the name of Air Products and Chemicals, Inc.

Respectfully submitted,



Joseph D. Rossi
Registration No. 47,038
7201 Hamilton Boulevard
Allentown, PA 18195-1501
(610) 481-8169